DATE: **January 25, 2007**

SUBJECT: **Chemical Recovery Systems, Inc Supplemental Remediation Alternatives**

MEMORANDUM TO THE FILE - Documentation to support the additional Remediation Alternatives added to the Feasibility Study Report after approval of the RI/FS Report

FROM: Gwendolyn S. Massenburg, Remedial Project Manager
RRB #2, RRS #4

TO: Joan Tanaka, Chief, RRS #4

The purpose of this Memorandum is to document additional Remediation Alternatives added to the Feasibility Study Report after approval of the RI/FS Report, September 2006 for Chemical Recovery Systems, Inc. During the approval process for the Proposed Plan from the program, it was brought to my attention that we needed to follow policy that requires EPA to evaluate possible treatment alternatives, in addition to the no action alternative, and containment alternatives as a part of the Alternative Array for the site. The approved RI/FS Report did not evaluate a proposed treatment remedy for the site. EPA also wanted to know what the cost estimates were for a remedy that required only a portion of the site (0.5 acres/"hotspot") excavated. The RI/FS Report had an alternative that required excavation of the entire site (2.5 acres), without a soil cover, but not one with the hot spot removal, and soil cover.

EPA requested that the RPs provide us with the cost estimate for a half acre "hot-spot" removal. The RPs responded with a cost estimate to excavate the half acre portion of the site, with an asphalt cover for the remainder of the site. This cost estimate also included excavation 15 feet down, although the soil data suggested that contamination decreased significantly with depth. Therefore, EPA tasked its contractors to provide the cost estimate to excavate the 0.5 acres with a soil cover over the remainder of the site (2.0 acres). EPA also asked its contractor to provide cost estimates for a SVE treatment system for the "hot spot" with a two foot soil cover over the balance of the site (2.0 acres). The estimate provided (copy attached) by the contractor for the half acre removal and soil cover was $1,178,674 (Capital cost) plus the $563,000 annual O&M cost for 30 years equaled a total remedy cost of $1,741,674.

The cost estimate for the SVE treatment system for the half acre portion of the site, and a two foot soil cover of the remainder of the site were $577,230.00, without the 30-year O&M cost. During the SVE cost evaluation process, it was determined that due to the vertical profile of the area soil, (high water table, sandy soil, and refusal at the 8- 9 foot interval) in the contractors' best professional judgment, it was technically impracticable for the system to function properly. Therefore, the SVE treatment remedy was screened out of the Alternative Array. The contractor's **Overview of Remediation Options** is also attached to this document.

OVERVIEW OF REMEDIATION OPTIONS
CHEMICAL RECOVERY SYSTEM SITE
ELYRIA, OHIO

START contractor STN JV evaluated two soil remediation alternatives for the Chemical Recovery System (CRS) site located in Elyria, OH. These alternatives are:

1. Soil Vapor Extraction (SVE)
2. Soil Excavation and off-site Disposal

SVE Alternative:

The soil vapor extraction (SVE) alternative involves applying vacuum through extraction wells spread over the 0.5 acre area and recovering the soil vapors containing volatile contaminants. Vertical extraction wells at the CRS site could typically be from depths of 5 feet to 10 feet below ground surface (bgs). It is assumed that the volatile organic compounds (VOCs) collected through SVE system would have very low trichloroethylene (TCE) concentrations and can be discharged to the atmosphere without any treatment. Under ideal conditions, a SVE system can attain a maximum efficiency of 90%. Some of the key factors that determine the efficiency of an SVE system include:

1. Preferential pathways for air migration
2. Pressure drop
3. Area available for SVE

SVE EVALUATION:

In the proposed SVE remediation area, TCE concentrations ranged from 450 milligrams per kilogram (mg/kg) to 120 mg/Kg in the 0 to 4 ft bgs sample. The highest TCE concentration of 450 mg/kg was encountered in the 2-4 ft bgs depth sample of GP-37 location. A TCE concentration of 16 mg/Kg was observed in the 8 ft bgs sample. In the SVE area, higher TCE concentrations were encountered in the top 4 feet of the soil.

In general, fill material was typically encountered in the top 4 feet of the 0.5 acre area evaluated for SVE remediation. In some areas (GP-37), fill material with medium sand was observed up to a depth of 3.5 ft bgs followed by fine to medium sand up to a depth of 5.5 ft bgs. Refusal was encountered at a depth of 5.5 ft bgs in the GP-37 area. The GP-40 soil boring log indicated fill material with sandy clay in the 0-4 feet bgs interval and sandy clay up to 12 ft bgs. Groundwater was encountered at 12 ft bgs. The GP-39

soil boring log indicated fill material with medium sand, coal, glass and brick up to 8 ft bgs, moist soil with silty sand up to 11.5 ft bgs and refusal at a depth of 11.5 ft bgs. Soil boring logs shown in the remedial investigation report prepared by Parsons Engineering indicated refusal at less than 10 ft bgs in a majority of sample locations.

For SVE system to function efficiently, vertical extraction wells are typically used at depths of 1.5 meters (5 feet) or greater. Since most of the contamination is predominantly in the top 4 feet and located in fill, sand, and clay matrix, preferential pathways are likely to occur in the SVE area. Preferential pathways allow air to migrate predominantly through these preferred pathways and remove volatiles in and around these pathways only. This results in a reduced SVE efficiency. After the contamination in the preferential pathways is reduced, the SVE system would have to be shut down until contamination from other areas migrate in to the preferential pathways. This will prolong the time period of SVE system.

The fill material typically has voids that are detrimental to maintaining a constant pressure. A constant pressure is essential for effective SVE operations. Fill material in the proposed SVE area may lead to significant pressure drops thus drastically reducing the vacuum capabilities and vapor extraction efficiency.

In a typical SVE process, induced vacuum results in the upwelling (rise) of the groundwater table and reduction in the available treatment area. With the depth to bedrock ranging from 5 to 12 feet in the proposed SVE area and the close proximity to the river, increase in precipitation events and flooding from the river would create a perched aquifer thus reducing the actual area available for SVE remediation. This condition coupled with upwelling of the water table because of induced vacuum would decrease the area of SVE remediation and decrease SVE efficiency. The shallow bedrock and the close proximity of the river to the site would require additional measures to reduce the quantity of water drawn in to the SVE system. In spite of this, considerable quantity of water may find its way in to the SVE system requiring treatment and disposal per state and federal applicable standards.

One of the disadvantages of SVE system is that concentration reductions greater than 90% are difficult to achieve. The highest TCE concentration of 450 mg/kg encountered at the site would undergo a reduction of 405 mg/kg and still leave behind a concentration of 24 mg/kg. The site cleanup goal of 0.11 mg/kg will not be achievable with SVE system. A 90% reduction in the average TCE concentration of 102 mg/kg in the 0.5 acre area will result in TCE concentration of 10.22 mg/kg in the remainder of the soil. An 80% TCE concentration reduction would result in 20.44 mg/kg while a 70% concentration reduction would

result in 30.66 mg/kg concentration of TCE in the remainder of the soil at the site. Because of shallow bedrock conditions, perched groundwater, and fill and clay material at the site, the ideal efficiency of 90% would not be attainable at the CRS site.

EXCAVATION ALTERNATIVE

The Excavation Alternative involves excavating the 0.5-acre section of the CRS site up to an average depth of 6 ft bgs. This average depth is based on the assumption that some areas may require excavation up to 4 ft while other areas require excavation up to 6-8ft bgs. This action will remove high concentrations of TCE in soil up to the bed rock in some sections of the 0.5 acre area. The highest TCE concentration of 450 mg/kg was encountered within the top 6 ft of the soil. After removing this contamination at the 6 ft bgs area, the highest concentration remaining at the site would be 16 mg/kg. After addressing the contamination at the 8 ft bgs area, the highest concentration remaining in the 0.5-acre area would be 0.99 mg/kg. The alternative also includes backfilling the excavated area with clean soil and installing a 2-foot soil cover over the rest of the site area. The excavation alternative provides a reliable alternative and removes immediate threat to human health and the environment through direct contact and through potential leaching in to the groundwater from the 0.5 acre area at the CRS site.

CONCLUSIONS

The SVE alternative, because of site conditions discussed above, may not be able to remove TCE concentrations effectively and in a reasonable time period to meet the desired project objective of abating direct contact threat and reducing the TCE concentration to 0.11 mg/Kg. Excavation alternative offers a one-time remedy where site contamination up to 8 ft bgs could be removed, leaving a maximum residual contamination up to 0.99 mg/Kg in the soil. The Excavation alternative also abates the direct contact threat once the remedy is completed and minimizes further leaching and reduced the time frame for natural attenuation.

	A	B	C	D	E	F	G	H
1	**CHEMICAL RECOVERY SYSTEM SITE**							
2	**ELYRIA, LORAINE COUNTY, OHIO**							
3	**COST ESTIMATE FOR SVE SYSTEM**							
4								
5								
6	**Phase I**	**Pilot Study**						
7	Drillers for Geotech analysis							
8	assume 10 geoprobe			$2,000.00				
9	collecting for Geotech analysis			$36,000.00				
10	pilot study*			$14,250.00				
11								
12								
13	**Phase 2**	**SVE Installation**						
14	drilling 10 vapor wells			$13,380.00				
15	SVE piping installation*			$75,000.00				
16	SVE system*			$100,000.00				
17	asphalt cap***			$10,000.00				
18	2 ft backfill cover			$130,000.00				
19								
20	**Total Installation and pilot study**			**$380,630.00**				
21								
22	**Phase 3**	***O&M***						
23								
24	**Assume**							
25	sampling 1/quarter for 1-3 years							
26	Travel for sampling							
27	Year 1							
28		Travel time 2 people/trip		$1,000.00				
29		Travel costs 2 people/trip		$300.00				
30		hours sampling/trip		$4,000.00				
31		analytical/trip		$3,000.00				
32		maintence**		$19,000.00				
33		Reports		$30,000.00				
34		4 trips		**$82,200.00**				
35	Year 2							
36		Travel time 2 people/trip		$2,000.00				
37		Travel costs 2 people/trip		$600.00				
38		hours sampling/trip		$6,000.00				
39		analytical/trip		$3,000.00				
40		Reports		$5,000.00				
41		maintence		$6,000.00				
42		4 trips		**$57,400.00**				
43	Year 3							
44		Travel time 2 people/trip		$2,000.00				
45		Travel costs 2 people/trip		$500.00				
46		hours sampling/trip		$6,000.00				
47		analytical/trip		$3,000.00				
48		Reports		$5,000.00				
49		maintence		$6,000.00				
50		4 trips		**$57,000.00**				
51								
52			TOTAL COST	**$577,230.00**				
53								
54	**Assumptions**							
55	20 wells							
56	system is installed at the center of the site							
57	soil is sandy							
58	area can be capped by asphalt							
59	O&M will be conducted for 5 years							
60	reports for the first year include health and safety plans, work plans, sampling plans etc.							
61	* estimated quote from Mark Steiner at Chem Phiron, Inc.							
62	** maintence cost include changing out carbon for air treatment and weekly inspection of the system to ensure							
63	system is working properly,							
64	***asphalt cap is assumed to be installed over 0 5 acres of the site to prevent short-ciruiting and make the system							
65	more efficient							
66	$95 per hour of pilot study, can be done in 8 hours plus travel time							
67	SVE piping installation is estimated at $75/linear feet assuming 20 wells at 50 feet							
68								
69	In soil borings shown that were collected previously on the site, refusal was common at 5.5 ft to 11 ft below ground							
70	surface. An SVE system would have a very low efficiency at these shallow depth due to short circuiting of air.							
71	it is assumed a 2 foot backfill cover would be placed on the 2.0 acres of the site not covered by asphalt							

Monitoring Well Network Cost Estimates
Chemical Recovery System
Elyria, Ohio

Cost estimates were developed for vertical profiling at 7 potential shallow and deep monitoring well locations and installing 11 monitoring wells. These activities were assumed to be conducted in four phases. Phase 1 and phase 2 involve well profiling and monitoring well installation on the site and phase 3 and phase 4 involve well profiling and monitoring well installation outside the site boundaries. The estimated cost of $298,612 is based on quotes obtained from the drillers.

Phase 1
Phase 1 involves vertical profiling four potential monitoring well locations using water rotary drilling techniques. Chemical analysis samples for trichloroethylene (TCE) contamination would be collected from five-foot intervals and analyzed at a commercial laboratory.

Phase 2
After evaluating the results of phase 1, five monitoring wells will be installed within the site boundaries. Because some of the monitoring wells have to be installed in the bedrock, water rotary drilling technique would be the most viable method of installing the wells at the site.

Phase 3
Phase 3 involves vertical profiling of four locations just outside the site boundary and across the river as shown in Figure 3-10. However, due to the terrain and local conditions in the site area, a drill rig may encounter mobilization problems. Such locations may have to be relocated based on drill rig accessibility. Similar to phase 1, chemical analysis samples will be collected and analyzed during phase 3 activities.

Phase 4
Six monitoring wells will be installed in phase 4 based on phase 3 evaluation. These wells will be installed using the water rotary drill technique.

These cost estimates could be further streamlined, if work activities can be conducted in two phases instead of four phases. This will reduce 2 mobilizations and demobilizations and associated cost and time.

Under this streamlined approach, vertical profiling and monitoring well installation on the site itself would occur during first mobilization and outside the site boundaries would occur during the second mobilization. Samples will be analyzed within a 24-hour time period of each vertical profiling well sampling. While waiting for the chemical results of one location, vertical profiling at the next location would occur. Monitoring wells will be installed either after completing well profiling of all wells are between vertical profiling of individual wells.

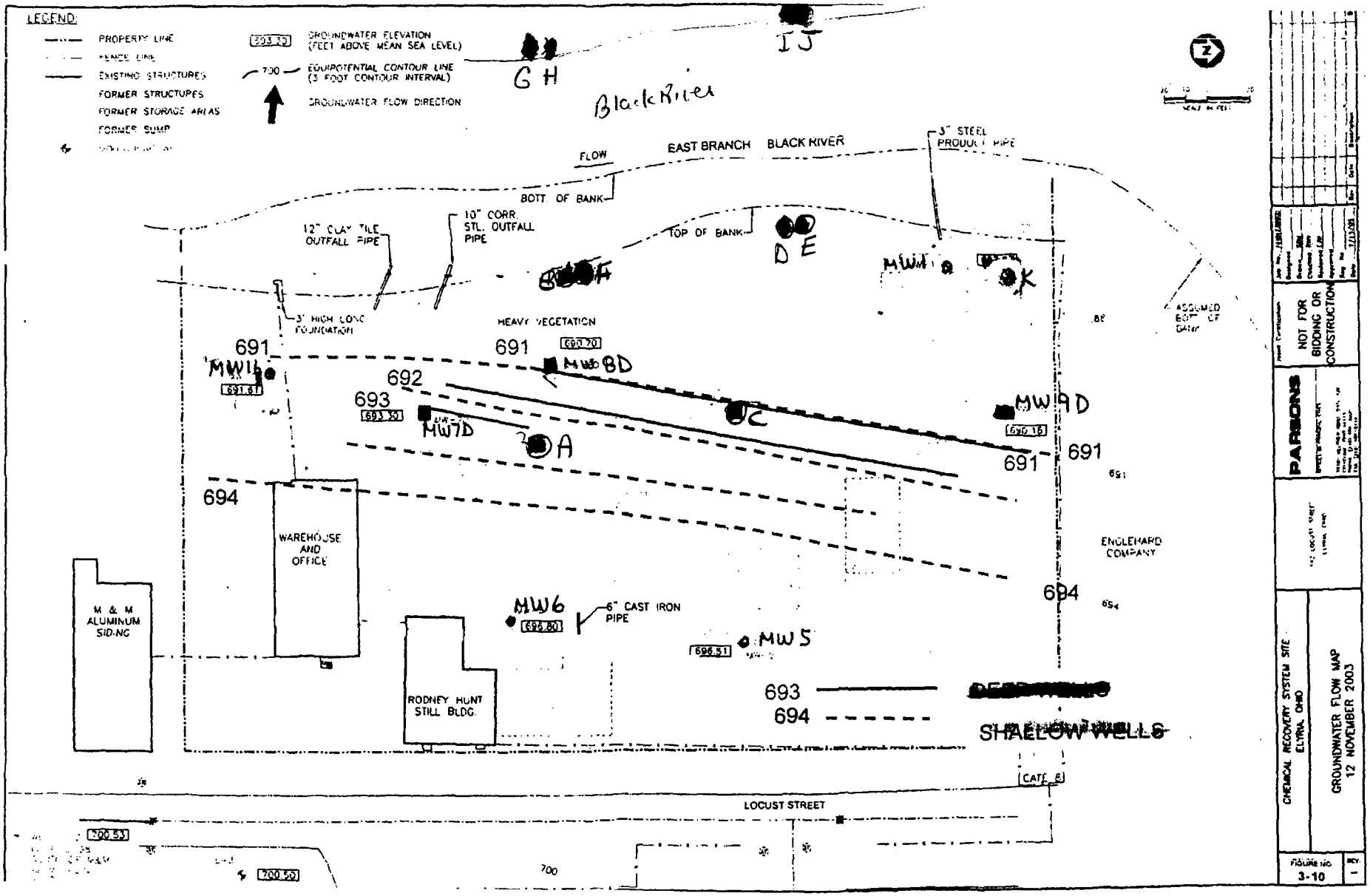
CHEMICAL RECOVERY SYSTEM SITE
ELYRIA, LORAINE COUNTY, OHIO
Monitoring Well Vertical Profiling and Installation Cost Estimates

Activity	Description	Quantity	Unit Cost	Cost
Subcontractors				
Phase 1				
Vertical Profiling-4 Wells				
Mobilization & Demobilization	2 five hour days + drill rig	Lump Sum		$2,800.00
Labor and drill rig - regular time	2 crew members/8hrs per day	6 days	1,400	$8,400.00
Labor overtime	overtime hours	2	262.5	$525.00
Perdiem	2 crew members	5 days	200	$2,000.00
Drilling material/items				
Bentonite, pump, tube, drums	well profiling and related costs	Lump Sum		$3,790.00
Project Administration	labor	Lump Sum		$1,080.00
Chemical analysis	TCE in soil	30	200	$6,000.00
Disposal of water and borehole cuttings	55-gallon drums	12	175	$2,100.00
EPA/Contractor oversight	plan approvals and field oversight	10 days	100	$10,000.00
Phase 1 Total				$36,695.00
Phase 2				
Monitorng Well Installation - 4 wells (3-20" and 1-50" well)	mob/demob and labor	5 days	1,400	$7,000.00
Larbor overtime	overtime hours	2	262.5	$525.00
Perdiem	2 crew members	4 days	200	$800.00
Drilling material/items				
Well risers, screen, etc	Well construction	4 wells	LS	$9,699.00
Well development	Development of wells - Labor	5 8-hr days	100	$4,000.00
Project Administration	labor	1 LS		$1,560.00
Chemical analysis	TCE in water	5	60	$300.00
Disposal of water and borehole cuttings	55-gallon drums	4	175	$700.00
EPA/Contractor oversight	plan approvals and field oversight	10, 10-hour days	100	$10,000.00
Phase 2 Total				$34,584.00
Phase 3				
Vertical Profiling- 3 Wells				
Mobe/demobe/drilling	2 crew members/8hrs per day	6	1,400	$8,400.00
Labor overtime	overtime hours	2	262.5	$525.00
Perdiem	2 crew members	6 days	200	$1,200.00
Drilling material/items				
Bentonite, pump, tube, drums	well profiling and related costs	Lump Sum		$2,842.50
Project Administration	labor	Lump Sum		$1,320.00
Chemical analysis	TCE in soil	20	200	$4,000.00
Disposal of water and borehole cuttings	55-gallon drums	9	175	$1,575.00
EPA/Contractor oversight	plan approvals and field oversight	7 days	100	$7,000.00
Phase 3 Total				$26,862.50
Phase 4				
Monitorng Well Installation - 7 wells (4-20" wells and 3-50" wells)	mob/demob and labor	10 days	1,400	$11,200.00
Larbor overtime	overtime hours	2	262.5	$525.00
Perdiem	2 crew members	10 days	200	$2,000.00
Drilling material/items				
Well risers, screen, etc	Well construction	7 wells	LS	$19,317.00
Well development	Development of wells - Labor	5 8-hr days	100	$4,000.00
Project Administration	labor	1 LS		$1,080.00
Chemical analysis	TCE in water	8	60	$480.00
Disposal of water and borehole cuttings	55-gallon drums	7	175	$1,225.00
EPA/Contractor oversight	plan approvals and field oversight	10, 10-hour days	100	$10,000.00
Phase 4 Total				$49,827.00
Miscellaneous				
Project Setup, procurement	Field clerk	3 weeks		$675.00
Other miscellaneous items				$2,000.00
Total				$298,612.00

Assumptions

1. Labor costs are based on Davis-bacon act wages
2. Chemical analysis costs for vertical profilng samples are based on a 24-hour turnaround time
3. Driling quote used here was obtained from Geo Services, Inc of Illinois for water rotary drilling
4. During vertical profiling, soil samples were assumed to be collected from 5-foot intervals and analyzed for TCE

Cost estimates prepared by STN Environmental, JV, under START contract EP-S5-06-03 and TDD number S05-0701-001


LEGEND:
PROPERTY LINE
FENCE LINE
EXISTING STRUCTURES
FORMER STRUCTURES
FORMER STORAGE AREAS
FORMER SUMP
693.20 GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)
700 EQUIPOTENTIAL CONTOUR LINE (5 FOOT CONTOUR INTERVAL)
GROUNDWATER FLOW DIRECTION
G H
I J
Black River
FLOW
EAST BRANCH BLACK RIVER
3" STEEL PRODUCT PIPE
BOTT. OF BANK
TOP OF BANK
12" CLAY TILE OUTFALL PIPE
10" CORR. STL. OUTFALL PIPE
D E
MW11
K
3' HIGH CONC FOUNDATION
HEAVY VEGETATION
ASSUMED EDGE OF WATER
691
691.61
MW11
692
693
693.30
MW7D
691
690.70
MW8D
MW9D
690.16
691
691
694
694
WAREHOUSE AND OFFICE
ENGLEHARD COMPANY
M & M ALUMINUM SIDING
MW6
696.80
6" CAST IRON PIPE
MW5
696.51
RODNEY HUNT STILL BLDG.
693
694
SHALLOW WELLS
CATE ST
LOCUST STREET
700.53
700.50
700
PARSONS
NOT FOR BIDDING OR CONSTRUCTION
CHEMICAL RECOVERY SYSTEM SITE
ELYRIA, OHIO
GROUNDWATER FLOW MAP
12 NOVEMBER 2003
FIGURE NO.
3-10
REV.
1